A portfolio of sound art installations that employ modern reactive and interactive technology through systems-based mechanisms

By
Anthony James Morton

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Abstract

This portfolio comprises three pieces of work that were created between 2015 and 2018. The focus was threefold; to explore emerging technologies in relation to sonic creation, to explore interactive and reactive processes and to explore systems-based mechanisms. The range of work manifested as a range of sonic art installations linking reactive and interactive technology with both sound and vision experiences. The aim was not to create fixed compositions, but to create musical "systems" that allowed dynamic changes depending on how the piece of work was interacted with. Systems were created with fixed rules and boundaries, but the content could change into an infinite number of permutations, set within the rules given. This allowed each piece of work to change over time, never responding in exactly the same way.

Through working with and exploring these technologies, a set of socio-political themes emerged in the works—most times this emergence was organic, but on other occasions it was directed by the medium used.

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Media Contents

Accompanying this commentary is a collection of media files, all of which can be found here:

http://www.tonyjamesmorton.com/academic/

The contents of the media and folder structure are specified below.

\if the walls could sing

- **If the walls could sing.mp4 -** Video recording of the installation in situ at TESTT Space art gallery
- **If the walls could sing PERFORMANCE VERSION.mp4 -** Video recording of performance version of installation
- A collection of five photographs of the piece in situ at TESTT Space art gallery

\if the walls could sing\Installation files

- **If the walls could sing.maxpat** – A Max/MSP file of the final installation
- Four video recordings of the choir members (**ALTOCC.mp4, BASSCC.mp4, SOPCC.mp4, TENCC.mp4**)
- Four audio recordings of the choir members (**ALTOCC.wav, BASSCC.wav, SOPCC.wav, TENCC.wav**)
- **NEWGRAINZ.maxpat –** Granular synthesizer for use in the poly object

\8bit news

- **8bit news.mp4 -** Video recording of the installation in situ at TESTT Space art gallery
- A collection of five photographs of the piece in situ at TESTT Space art gallery
- **8bit news.wav** – Stereo recording of the installation

\8bit news\Installation files

- **8bit news.maxpat -** A Max/MSP file of the final installation

\#max140beats

- **#max140beats.mp4** - Video recording of the installation in situ at TESTT Space art gallery
- A collection of five photographs of the piece in situ at TESTT Space art gallery
- A collection of six video recordings all named all named after the Twitter search used **(#brexit.mp4, #fun.mp4, #spam.mp4, #giveaway.mp4, @realDonaldTrump.mp4, @FoxNews.mp4)**

\#max140beats\Installation files

- **#max140beats.maxpat –** Max/MSP file of the final installation
- **tweetapi.js –** Javascript code to access the Twitter API
- A collection of image files that are used for the display of the installation **(greentwitter.png, pinktwitter.png, redtwitter.png, whitetwitter.png, yellowtwitter.png)**

- **negative-words.txt** and **positive-words.txt** – Sentiment dictionaries

\#max140beats\Trump in C Major

- A collection of four recordings submitted to the ART23 open call (**Trump 1.wav, Trump 2.wav, Trump 3.wav, Trump 4.wav**)

1. INTRODUCTION

This portfolio comprises three audio/visual (A/V) installations that combine; interactivity/reactive input, use of emerging technology and system-based mechanisms. The contextual theme running through each piece is a narrative on socio-political issues facing modern society. The purpose was to create a range of ever-changing A/V installations that allows for each viewing of the work to be different from the last. Two of the works presented allow audience interactivity and manipulation via two different methods of real-time input, with one piece responding to physical movement and the other with the use of mobile technology. This allowed for unique reinterpretations of the work depending on the viewer's input. The third piece became a reactive installation, responding to external communication via internet web pages.

The compositional approaches presented in these pieces were influenced by two concepts drawn from post-war modernism. First, the idea of 'process music', a term coined by minimalist composer Steve Reich; and second, 'generative music', a style of music popularised by Brian Eno. Both process music and generative music can be conceived as systems-based methods, because the compositional process is invested in the design of an algorithm that unfolds in time, usually without authorial intervention in the process. Systems-based art extends beyond music to include media art, conceptual art, robotics and more. The idea that each work would become a program in which a different input (often non-musical) determines a different output was informed by these systems-based ideas, particularly as they are manifest in the works of Roy Ascott and Jack Burnham. Burnham and Ascott were also interested in exploring new digital technologies in their work, an ethos that equally informs this portfolio.

Another systems-based artist that influences my work is Hans Haacke. As well as being an advocate of systems-theory, he often used real-time systems as a central focus to his work. Haacke was one of the first artists to use art as an institutional critique, challenging convention as well as the funders of such establishments. His work *MoMA Poll* (1970) would comment directly on the involvements of a major donor and board member at MoMA, Nelson Rockefeller. *In A Breed Apart* (1978), Haacke reworked an advert for Jaguar cars by British Leyland to accuse the company of supporting South Africa's apartheid regime by selling it police and military vehicles. Haacke's work was important in understanding and working with the unforeseen social and political content that emerged in my works. Each piece presented looks at modern socio-political themes facing the world today.

The following sections will contextualise the methods implemented within the works included in this portfolio with relation to the key themes; interactive art, systems aesthetics and political art. Finally, I will discuss the works themselves, providing a critical analysis of their concepts, design and implementation.

1.1 Presentation of thesis

This thesis is presented in a practice-as-research format, with emphasis placed on the creative exploration of my practice. The purpose was to explore several different themes related to systems-based composition methods and use these findings to influence my own practice. Although the aim was to create a range of interactive and reactive systems-based installations, several themes presented within this style were used as a focal point. These themes were; parameter mapped sonification, the use of real-time data as an input mode, the emerging use of mobile technology for interaction and the use of human movement as an interaction method. These key themes will be contextualised through researching existing works which in turn will help influence and guide my own practice. Each piece will then be related to these original works thematically.

1.2 Overview of individual pieces

If the walls could sing, is an interactive audio/visual installation which enables participants to personify an individual member of a close harmony ensemble. The space is seemingly empty, but as an observer enters, their choral avatar is projected and starts to sing. The observer's movement within the space is then used to control the singer. As more observers enter the space, more singers appear, allowing collaborative interaction of a normally linear musical piece. The premise of the piece is based around the increase in walls or barriers being built, creating physical divides between nations or cultures. The piece employs the use of the Microsoft Kinect sensor to track an observer’s movement within the space; their coordinates within the space are used to manipulate the playback of the video and audio. Max/MSP is also used exclusively to

create the work. This piece has previously been displayed at Orbit UK Art Graduates Show, OXO Tower, London (UK), BEAST FEaST, Birmingham (UK) and TESTT Space, Durham (UK)

#max140beats is an interactive audio/visual installation which generates small compositions from Tweets. Observers can send a search query, via Twitter, to the hashtag #max140beats. The piece then picks up the search query and retrieves the newest Tweet published, which in turn is generated into music using a form of music cryptography. The premise of this piece is based on the increase in spam Twitter users, bots and trolls, the idea to generate something useful from something undesirable. This piece exclusively uses Max MSP, with the Java Script language being used to access the Twitter API to retrieve Tweets. The piece has been previously displayed at TESTT Space, Durham (UK).

8bit news is a reactive AV installation that uses real-time RSS news reports to create a generated soundscape in real-time. A wide range of news reports are polled regularly from a range of sources; left-leaning, right-leaning and from the centre. These news reports are then used to create musical sequences, with reports from each of these three groups represented by a different timbre and tonality. When a new report comes in, the installation converts this text into binary form, displaying it as scrolling text (a list of 1's and 0's). These numbers are used to trigger sounds, effectively turning the reports into a large musical sequencer. The premise of this piece is based around the term ’fake news’, coined by Donald Trump, as an attack on news sources that were outputting reports that were critical of him. By breaking down these news reports into their simplistic digital form, we remove all bias and influence, what we are left with is a sonified

reinterpretation of binary form. This piece uses Max MSP for the retrieval of news reports and conversion into MIDI events. Ableton Live is then used to host a series of VST instruments to play back this MIDI information. The piece has been previously displayed at TESTT Space, Durham (UK).

1.3 A partial history of interactive and systems-based art

This portfolio explores interactive and systems-based approaches to installation art. One of the defining aspects of this work is the central role of audience participation in the experience of the artwork. The behaviour of such an audience causes the work to change over time. Unlike a static painting, or other fixed media work, the audience's response to the work becomes part of the work itself, forming the focal point of the piece. The origins of interactive art are up for debate, but one of the first modern day artists to employ such audience participation is Marcel Duchamp. His piece *Rotary Glass Plates* (1920) invited the audience to turn on the running motor of the device and explore the optical illusions created. Marcel Duchamp claimed that "A work of art is completed by the viewer", implying that without an audience there isn't an artwork. A further development of interactivity came in Roy Ascott's series of work *Change-Paintings* (1959). These works invited viewers to re-order a series of Plexiglas slabs to create new images from the original composition. A different approach to interactive art was created in 1972 by artist Saint Phalle. Phalle's piece *Golem* was a giant playground installation commissioned for children in the City of Jerusalem. Although *Golem* is certainly an unorthodox piece, blurring the lines of structure and art, it nevertheless requires interaction, creating an 'artwork-event'. This approach to audience participation to create the purpose of the artwork mirrors that of Duchamp's ideology. As technology developed, so did interactive art. Jack Burnham's curated

exhibition *Software* (1970) displayed work by many artists employing interactive machines and computers. *Labyrinth: An Interactive Catalogue* (1970), a piece by Ned Woodman and Theodor H. Nelson, was an 'interactive text retrieval system'. In fact, it was the first public demonstration of a hypertext system.

The birth of the digital age has since given rise to a multitude of interactive art, employing; motion detectors, voice detection, touch-based controllers and the use of mobile technology. Maurizio Bolognini's piece *SMSMS* (Short Message Service Mediated Sublime, 2000) is an interactive installation in which audience members are invited to engage through the use of SMS text messages. The communication structure was intended to be similar to that of an e-democracy.

In each of these works there is an employed systematic approach, a specific framework created for the viewer to participate within. It can therefore be helpful to view each piece of work as a system, a mechanism of parts working together in tandem. With Ascott's *Change-Paintings*, a solid structure or framework gives birth to a multitude of possible permutations. Jack Burnham's conceptual show, *Software*, not only casts art in terms of technology but as a sort of "systems aesthetics," creating a two-way communication between participant and artwork (Terranova, C, n.d.). Burnham's fascination with cybernetics became a theme throughout his work, with writings on real-time systems. Ascott also held an interest with cybernetics. In his paper *Behaviourist Art and the Cybernetic Vision* (1966-67), Ascott even discussed the possibilities of artistic collaborations remotely over computer network. Jasia Reichardt's curated exhibition *Cybernetic Serendipity* (1968), popularised the idea of joining cybernetics

with art. The exhibition also included a selection of music that utilised the computer both as a tool to compose with and sound-making instrument. Peter Zinovieff's composition *January Tensions* (1968) was created on a computer system which had the ability to react to audio input, sampling and then re-arranging to create a musical piece.

Burnham's influence can also be found in the work of artist Hans Haacke, again with his use of changing, real-time systems. A good example of this is Haacke's piece *MoMA Poll* (1970), presented at the MoMA gallery in New York. The piece comprised two transparent acrylic ballot boxes, one marked "yes" and the other "no." A question was posed to the audience members, "Would the fact that Governor Rockefeller has not denounced President Nixon's Indochina Policy be a reason for you not voting for him in November?" The physical input of the system clearly being answered with audience participation.

There is certainly an intrinsic link between interactive and systems-based art and emerging technology. As discussed above, artists such as Burnham and Ascott wrote about the themes of cybernetics and telematics within art. Their artwork would develop, utilising modern technologies, especially with the use of digital technology and computers. All of the pieces created by myself, which are presented in this portfolio, explore modern technology as a way of facilitating an input. Be it the motion sensor technology in the piece *if the walls could sing*, the use of social media and mobile technology within *#max140beats*, or the process of accessing and downloading news reports in real-time; each piece would be impossible to exist if not for these modern technologies.

1.4 Political Narrative within conceptual and systems-based art

Art and politics have always had a deep-seated link, particularly at times of social change or when employed as a form of protest. The turn of the twentieth century certainly popularised the theme of expressing political feeling within art. Dadaism was a movement considered to be the first conceptual art movement in which the focus was not on creating aesthetically pleasing artwork, but to put forward a socio-political statement. The movement, often called 'anti-art', arose in the early twentieth century as a reaction to World War I and the nationalist movement, which they believed to be the cause of the war. Artists such as Marcel Duchamp and Hans Arp would employ the use of everyday objects, forcing questions about artistic creativity and the sheer definition of 'what was art?' Arp would also often use the idea of chance, or randomness, within his work His piece *According to the Laws of Chance* (1933), was created from dropping painted pieces of paper onto a structure. Duchamp often made use of 'readymade' items, selecting mass-produced, commonplace objects, again challenging the meaning of art. His work *Bicycle Wheel* (1913) was made from a bicycle wheel and a wooden stool. Duchamp's work would be influential in the emergence of the conceptual art movement in the 1960s. This movement would put emphasis on the meaning of the piece, instead of the final product. It's also worth noting that the piece *Bicycle Wheel* was in fact interactive, with Duchamp intending for the audience to spin the bicycle wheel.

Hans Haake is a certainly a purveyor of systems-based processes, but his work also holds a deep-rooted political narrative. For example, his work *MoMa Poll* (1970) was in fact a form of institutional critique. Haacke drew connections between the political agenda of Nelson Rockefeller and the art establishment. Rockefeller's family was closely identified with the

museum and Rockefeller himself had been a president of the museum as well as the governor of New York State. Another of Haacke's works, *Shapolsky et al. Manhattan Real Estate Holdings, a Real-Time Social System, as of May 1, 1971* (1971), became the focus of controversy. The work exposed the property transactions of the Shapolsky et al. Manhattan Real Estate Holdings, which in 1971 represented the biggest concentration of real estate in New York. The records of such properties, often found in ethnic minority areas, were culled from the New York City public records. Covering twenty years, about seventy companies had been the owners of such properties, often interchanging between hands to obscure ownership and to gain fiscal advantages. The work was to be displayed in the Guggenheim museum but the exhibition itself was cancelled. Thomas Messer, director of the museum at the time, called the piece 'inadequate' and refused the piece, along with two other works of Haacke (Macba.cat, no date.).

1.5 Overall Compositional Approach

The pieces presented within this portfolio all explore non-standard forms of composition. It was always my intention to create these works through flexible systems, with each interaction, or viewing, being different from the last. I enjoy the idea of reinterpretation and the use of chance within composition, taking inspiration from the works of; Steve Reich, Terry Riley, Cornelius Cardew, John Cage and Brian Eno, to name just a few. Reich is certainly a composer whose work is rooted in systems-based ideas. In his essay *Music as a Gradual Process* (1968), Reich discusses his interest of using process as a compositional tool in creating gradual changes and movement, stating "I am interested in perceptible processes. I want to be able to hear the process happening throughout the sounding music." Terry Riley is another minimalist composer who

works extensively with systems. For example, his piece *In C* (1968), notates a collection of simple ostinatos with the musical form governed by a specific set of rules. Due to these rules, every time the piece is performed it becomes completely different from the last. In fact, Riley doesn't even define the actual instrumentation of the piece, allowing more possible reinterpretations. There are certainly differences in Reich and Riley's approaches to composing. Reich argued that improvisation cannot be a feature of process music, concluding that the distinctive feature of musical processes not only determines the "the note-to-note details," but also the overall form of the composition (Reich, 1968). I would tend to disagree with his statement, arguing that Riley's composition *In C* employs the same systematic approach but allows a level of improvisation within the given framework.

Cornelius Cardew became another influence within this portfolio, especially with his piece *The Great Learning, Paragraph 7* (1971). The score is presented as a list of lyrics, again, with a set of rules or 'procedure.' Each singer starts on their own pitch, creating an always unique starting point from which to progress. Each singer also uses their own internal metronome. There is no single pulse to the piece, giving performers the freedom to move on as they wish. This use of different pitches and pulses create ever moving harmonies. This piece was certainly an influence in my work *if the walls could sing,* where audio parts can move independently of each other, playing back as different layers at the same time. Due to the nature of this piece, again, it is never performed the same way twice, with each performance becoming an interpretation of the set rules given.

Another compositional method explored in this portfolio is that of generative and algorithmic composition. In fact, it was one of Roy Ascott's pupils, Brian Eno, who became pivotal in the use of computer-based systems for music composition. *Generative music 1* (1996) by Brian Eno popularised the term "Generative Music." This body of work was only published on floppy disk, requiring a specific sound card to playback the compositions in its intended form. Although Eno popularised algorithmic music, it's important to note that algorithmic music existed well before Eno's work. In 1757 C.P.E Bach wrote an essay titled *Einfall, einen doppelten Contrapunct in der Octave von sechs Tacten zu machen, ohne die Regeln davon zu wissen* ('A method for making six bars of double counterpoint at the octave without knowing the rules') which provides a process for creating random counterpoint compositions. This 'game' was in fact a musical system which used a die to randomly generate a piece of music from precomposed options. One such algorithmic model employed in my piece *#max140beats* is that of a translational based algorithm, converting text into music. A popular model of such is J S Bach's 'Bach motif', a form of music cryptology, converting his name into melody form. This can be extensively heard in his work *The Canonic Variations on 'Vom Himmel hoch da komm' ich her'* (1747). My other piece, *8 bit news*, works in a similar 'translational' way. However, instead of assigning pitches directly to each letter, the text is in fact broken down into binary form. This binary form is then used as pitch information within a created step sequencer.

2. FOCAL THEMES WITHIN SYSTEMS-BASED ART

Whilst each work presented centered on system-based mechanisms, several focal themes stylistic to the genre were explored. These themes were; parameter mapped sonification, the use of real-time data as an input mode, the emerging use of mobile technology for interaction and the use of human movement as an interaction method. The following sections will comment on each focal theme and contextualise against existing works, providing an analysis of their concepts, design and implementation.

2.1 Sonification

Sonification is the process of turning non-aural information into sound. Or, more specifically, "*sonification is the transformation of data relations into perceived relations in an acoustic signal for the purposes of facilitating communication or interpretation"* (Kramer et al. 1997). By its very nature, sonification is considered interdisciplinary, integrating concepts from human perception, acoustics, design, the arts, and engineering. Engineers and academics who study the use of sonification often call it *auditory display*, and besides it being artistically interesting, it can have important functional applications. The motivations behind sonification are similar to that of representing data in graphical form, that by mapping information from one domain onto another we can perceive the data in a new way and help to interpret it. Instead of visualising the data, we can represent it in aural form.

As put forward by Hermann, Hunt and Neuhoff in the paper *The Sonification Handbook* (2011), there are four main functions of sonification:

1. alarms, alerts, and warnings
2. process, and monitoring messages
3. data exploration.
4. art, entertainment, sports, and exercise

Perhaps the most successful example of sonification is the Geiger-counter, which was invented by Hans Geiger in the early twentieth century and is still in widespread use today. The Geiger counter is an instrument that emits a clicking sound in response to invisible radiation levels, alerting the user to the danger that may go unnoticed with a visual display, as well as allowing a continual awareness of the degree of danger. Sonification has also been successfully used in data analysis and exploration tasks, proving fruitful where visual techniques have not. During the Voyager 2 mission, researchers used audification to identify micrometeoroids, or small ring particles, hitting the Voyager 2 spacecraft as it traversed Saturn's rings. The impacts were visually obscured in the data but could be easily heard, sounding like intense impulses, almost like a hailstorm (Patel, 2014).

Various sonification techniques have been elaborated and formalised since the 1990s. The most widely accepted of these among the research community are described in detail in the *Sonification handbook*: audification, auditory icons, earcons, parameter mapping sonification, and model-based sonification.

Audification is defined as the direct playback of data streams as sound waves, allowing only some minor processing for the signal to become audible. A good example of audification is the work of Robert Alexander whilst a fellow at the NASA space program. Alexander used data

from NASA's Solar Wind satellite and converts this directly into sound. The sound is not intended to be musical as it is a direct translation, however changes in the sonic field can be helpful in interpreting data and making discoveries that a graphical system cannot. Alexander found that, through listening alone, the cause of a long-lived storm of swirling particles within the wind as well as an undocumented source of noise from the instruments aboard the *Ulysses* spacecraft. Another advantage of audification is the ability to condense large amounts of data into a short period of time. For example, Alexander was able to condense three hours of real-time recording into a three second audio clip (Patel K, 2014).

Auditory icons are based on an ecological approach to auditory perception, associating short environmental sounds with discrete events in the data in order to create metaphorical perceptual relationships, e.g. the mechanical clicking sound used in digital cameras when there is no need for such noise.

Earcons are similar to auditory icons but use entirely synthetic sounds with no prior metaphorical value, e.g. a melody indicating the battery level in mobile phones. *Earcons* create perceptual relationships that need to be learnt but can be easily parameterised and combined with each other to form hierarchical patterns of information.

Parameter mapping sonification consists of defining a set of mappings between the data and the auditory transmission. While simple to design, this technique has the potential to communicate information continuously, therefore being the most widely used sonification technique. Whereas it allows for a much greater flexibility than the previous techniques, the open-ended possibilities of the mapping design can perhaps make this solution less useful for scientific data

interpretation. Parameter mapping is normally the choice for artists and musicians looking to create music from data. A good example of this is Johannes Kreidler's work *Charts Music* (2009). Kreidler's piece uses the share prices of Lehman Brothers, General Motors, Bank of America and other companies during the global crash to create a satirical composition using Microsoft's *Songsmith* software. (Kreidler. 2019).

Model-based sonification was introduced by Hermann and Ritter in an attempt to move away from the simplicity of parameter mapping sonification. Specifically designed for interactive contexts, model-based sonification aims at benefiting from the learning abilities pertaining to everyday listening.

Two of the projects presented within this thesis use sonification as the musical process, although not specifically for scientific analysis. Both pieces, *#140beats* and *8-bit news* employ *Parameter mapping sonification techniques presented in contrasting methods.*

2.2 Use of Twitter

The use of social media as an interactive mode for artistic creation has steadily grown, with Twitter being a prime example of such interactive technology. Perhaps down to the amount of people who use the service, the ease of its API or the simplicity of its messaging service, many

artists have used Twitter as an input method for art installations and sonification projects. This section will present a contrasting range of artistic projects that utilise Twitter as an input method.

#tweetscapes (2011), created by Anselm Venezian Nehls and Tarik Barri, sonifies Tweets in real-time, creating an ever-lasting, autonomous composition. The installation reads and converts all German language Tweets into sounds and images in real-time as they are posted. The Tweet is broken down into several elements, with the *hashtag* becoming the most prominent sound component. This sound is presented as a short, one-shot sound. However, if a large number of Tweets are posted within a short period of time containing the same hashtag, a continuous background drone is created, linked to the original sound of the hashtag. Replies are sonified separately, with the sonic results similar to that of a short whisper. If Tweets do not contain a hashtag or are intended as a reply, the playback generated is short percussive sound. Re-tweets are also addressed using a delay type effect with higher re-tweets creating a more echoed sound. The piece uses its own sound synthesis, with each Tweet generating a unique sound. A form of music cryptography is used to convert the Tweet into a number. This number is then used to set the parameters of the specifically built synthesizer. As the installation looks at all German speaking Tweets, viewers within the space of the installation may also interact with the work. The installation becomes a commentary of Twitter users in Germany, presenting in real-time the topic of their conversations (Hermann, Nehls, Eitel, Barri and Gammel, 2012).

The Listening Machine is another Twitter sonification project. Created by Daniel Jones and Peter Gregson in 2012, *The Listening Machine* observes the interactions of 500 UK-based Twitter users in real time, translating their words, sentiments and social behaviours into a continuous

musical composition. The Twitter accounts chosen were selected from eight different fields; arts, business, education, health, politics, science, sport and technology. Commissioned by the BBC/Arts Council England, the project combined natural language processing and algorithmic composition with a vast array of orchestral fragments recorded by the Britten Sinfonia (Jones, 2012). Whenever these selected people post an update, the properties of the tweet are analysed in terms of the sound and meaning of the words, and music is then generated. Multiple, different elements make up the compositional process: sentiment analysis governs the mood of the piece; prosody analysis generates individual melody lines, based on subjects' syllables and rhythms of speech; and topic detection triggers preset modular segments and field recordings corresponding to given areas of conversation. The project ran for a total of six months, creating a "live soundtrack to the thoughts, opinions, feelings and conversations of the U.K.'s population, as played out on Twitter" (Solon, 2012). The work is an interesting combination of classical style instrumentation combined with digital music creation. Contrasting to *#tweetscapes*, the installation's sounds are made from pre-recorded musical content. Also, the work is not as directly interactive to viewers due to the preselected Twitter accounts it follows. These accounts also remain anonymous to the viewer and do not change throughout the period of the installation.

An interesting visual representation of Twitter is that of the piece *MONOLITT*, created by Syver Lauritzsen and Eirik Haugen Murvold. The piece reads Tweets from the surrounding area and applies sentiment analysis to them. The display method isn't digital, but is in fact presented as a paint-like fountain dripping over a small white monolith which dispenses paint on every Tweet returned. Like the rings of a tree, the paint becomes a historical map of social media activity. For

example, if someone in the area tweets something negative, the sculpture will ooze a burst of black paint whereas if someone Tweets a positive Tweet a pink paint will drip down the sculpture. The fact that the piece is silent doesn't detract from the similar aim achieved by previously mentioned installations. However, a large contrasting feature is that of the use of a mechanical process to create an output, instead of being digital. This mechanical process physically squeezes coloured paint from inside the monolith structure (Lauritzsen, n.d.).

2.3 Use of real-time data input

The use of real-time input is a common feature in interactive systems-based arts with Hans Haacke's *Moma Poll* (1970) being a good example of this. Real-time data input is often central to sonification, however not exclusive. The Geiger counter is a perfect example of the conversion of real-time data input into audio. In this section I will look at a selection of modern

work that employs the use of real-time data input as a central feature. Each piece of work utilises different input methods, from environmental sensors to communicational data and translate this data in contrasting ways.

Listening Post (2001) is an audio/visual art installation made by statistician Mark Hansen and artist Ben Rubin. The work is made up of 231 small LED digital screens arranged in a large grid. The work reads real-time conversations from various internet-based chat rooms and displays each communication as a line of scrolling text assigned to one of the screens. The communications appear as either whole or truncated phrases that include statements about nationality, age, gender, sexual preference, religion, politics or everyday life. The texts, which are constantly updated, are simultaneously read or sung by a voice synthesiser. Viewers are immersed in a sonification and visualization of thousands of simultaneous conversations happening on the internet at that moment in real-time (Modes, 2019). The work itself proved very popular, having originally been displayed at the Brooklyn Academy of Music in 2001, the London Science Museum in 2007, the NY Times building in 2011, and toured in 2013 from the permanent collection of the San Jose Museum of Art to Montpellier, France (Solon, 2012). Beyond its far-reaching influence in new media art, and despite the ten years of rapid technological change that have passed since it was debuted, Mark Hansen and Ben Rubin's installation *Listening Post* remains an outstanding engineering and aesthetic achievement in the realms of data visualisation, internet-connected sculpture, and real-time data mining technology (Modes, 2019).

Sonicity: Songs of Atoms Time and Space (2010) by artist Stanza is a responsive sound installation which reacts to environmental change from the space it is displayed. The piece is made up of one hundred and seventy speakers all connected and laid out on the floor of the displaying space. The sounds emitted from the system are the direct environment changes taken from the sensors employed within the room. Real-time data on; light, temperature, noise, humidity and the GPS position is used to create an audio sonification of the responsive environment that surrounds it. The artwork comments on themes around surveillance culture and privacy as well as posing the question of who actually owns the data (Stanza, 2010).

Artist Mathieu le Sourd (aka Maotik) created an immersive audio/visual installation with his work *Flow* (2016). The installation takes real-time data from; room temperature, humidity, audience position and the pull of the moon to create a virtual display of sea-like waves. Using eight different HD screens as well as projections onto the wall and floor, the artwork creates a fully immersive environment, creating ever-changing waves governed by environmental impact (Maotik, 2016). The installation is a good example of how real-time data can be used to create an infinite range of permutations and improvisations but be controlled by a specific set of rules. It also uses sensor data from an external environmental source, provided via online data of the moon's current position (Krueger, n.d.).

Tekja is a London-based art studio that specialises in data visualisation, creating; web applications, art installations and infographic animations. Their 2016 installation, *London Data Streams* delves deep into the minds of the city through data collected from Twitter, Instagram and TfL. *London Data Streams features* a live social media map of London, which uses the

Twitter Streaming API to gather tweets in real-time from all thirty-three London boroughs between 15 December 2015 and 14 January 2016. The installation sifts through around fifty thousand Tweets a day, analysing the sentiment of each one and displaying the words associated with each Tweet. The visual experience is similar to that of a large mind-map with words such as; ’love’ ’happy‘ and ’battles‘ being displayed over a large map of London at the precise GPS location it was sent from. The project incidentally revealed some interesting facts about the specific moods of Londoners. According to the project, Bexley is the happiest borough of London, with Sutton being the unhappiest. The sentiment analysis is created using a dictionary system in which each Tweet is compared and rated on a scale of minus 5 to plus 5. This process is also used in my own work *#max14beats.* The piece also reflects on the huge amount of data we generate and how much of that data is open to anyone (Tekja, n.d.).

2.4 Use of Microsoft Kinect sensor

The use of sensor technology in art is not an idea exclusive to the twenty-first century. For example, Glowflow, created by artist Myron Krueger in 1969, consisted of a darkened room containing phosphorescent pigment, lighted tubes and a floor covered in pressure sensors. Audience members explored the space whilst controlling the lighting of the room and the

changing of the accompanying synthesised sounds. Visually, Krueger considered *Glowflow* a success, but felt that it fell short of a true interactive environment because the participants were unaware of what specifically they were doing to generate each reaction (Krueger, n.d.).

David Rokeby's interactive sound installation *Very Nervous System* (1986) is a good example of how the advancement of digital technology helped in the creation of new interactive arts. Rockeby uses video cameras, image processors, synthesisers and computers to create a sound system space in which a participant's movement is linked directly to sound creation (Rokeby, 2010). The "invisible" interface was extremely ahead of its time and is very much akin to more modern projects that use the Microsoft Kinect.

This section will look at the usage of the Microsoft Kinect sensor within interactive art and provide examples of a range of work that the Kinect is central as a user interactive method.

Daniel Rozin is a digital artist who makes interactive sculptures. His work often utilises the Microsoft Kinect sensor to create pieces that change and respond to the presence of the participant. Rozin's *PomPom Mirror* (2015) is an interactive sculpture that mirrors the participant in front of it. The piece is made up of nine hundred and twenty-eight spherical pom poms, half coloured beige and the other half black with one of each colour combined in pairs. Each pompom is then attached to a motor, allowing it to move forward and backwards. Acting like pixels, the pompoms work in pairs, when one moves forward the other moves back, making visible only one of the colours at visible at one time (Howarth. 2015). When a person or object moves into view, the beige pompoms are swapped with the black ones to mimic the shapes and turn them into an image. The piece is not only a digital feat through its use of the Microsoft Kinect, but its mechanical nature is also impressive. The malleability of the pompoms' material

makes it the transition between beige and black look like an ink drop into water. It's interesting to see a different response to the use of the Kinect sensor as most artists stay with in the digital environment. Rozin not only creates something visually interesting but also technically interesting with the combination of digital operations and mechanical workings.

The Treachery of Sanctuary (2012) is a large-scale interactive art installation that utilises the Microsoft Kinect. The piece comprises three large screens sitting above a black reflective pool. Audience members are then invited to the edge of the reflective pool in front of each screen to interact with the display. On the first screen, audience members are displayed as a shadow before dissolving into a flock of birds that fly away. On the second screen, the birds re-appear and peck away at the audience member's shadow. And finally, on the third screen, the audience member grows wings from their arms (Holmes, 2014). The installation is minimal in nature and displayed only in monochrome colours. However, the sheer size of the installation is impressive as well as the quality of the animations. The piece uses the Kinect sensor in mapping and tracking audience member's body parts to use for animation system.

DELQA (2015) is an immersive audio-visual interactive installation created by musician Mathew Dear. Part musical performance and part climbing frame, the installation allows audience members to explore the musical atmosphere directly through the exploration of the space. Visitors enter and explore a mesh-covered, maze-like space through climbing and crawling where their controls musical parameters. The project uses eight Microsoft Kinect sensors create a full range of body interactions with music modes, lights, and a tangible space to climb, push, and roll against (Microsoft In Culture, n.d.). Both the visuals and the music responded intuitively to

the movements and interactions of the audience. The installation seeks to enhance the relationship between audience and performer and to deliver a unique live music experience, bringing the audience and performer closer together (Garcia-Vasquez, 2015).

3. IF THE WALLS COULD SING

3.1 Synopsis

This piece of work initially emerged from an exploration into granular synthesis. Having developed an audio granular synthesis, I became interested in linking the processed audio with video, creating a video based granular system. Similar processes had been demonstrated before, but not in such an interactive form. *Modell 5* (1994-96) by Japanese artists Akemi Takeya links both audio and video in a granular based process. The installation combines four independent projections, arranged side-by-side. Over time, each video changes, playing back a small fragment (or loop) of the given recording. The artwork is a fixed piece, composed and intended for playback in a standard, linear fashion. The intention for my piece was to allow a number of users the ability to interact with a given video projection, using a similar granular process in real-time.

Interactivity for the piece could have been achieved in various modes, however, the decision was taken to use participant movement. This would provide instantaneous feedback and allow participation in a simple of form, without any skill or familiarity needed. The interaction was also fitting to the granular synthesis process using movement to ‘scan’ the given audio. The Microsoft Kinect Sensor was used due to my familiarity of working with it in previous projects and the ease of which it can integrate with the Max package. As the Kinect sensor is limited to tracking up to four independent users, the idea was to create four virtual avatars, thus the idea became to create a virtual choir or a small close harmony group. This would also make sense when coming to compose a linear piece of music to be processed within the system, allowing a

four-part choral harmony composition to be used. A static choral composition was then created to form the core musical idea of the work. As the intention of the piece was to be projected onto a wall, the lyrical context centred around the idea of walls and boundaries. The lyrics are based on a poem by Robert Frost called *Mending Wall* (1914).

My intention was for the installation to remain silent and discreet until a user stepped into the space. Once the user steps into the area, their choral avatar is projected onto the wall and the user is then free to move around the space, directly interacting with the installation. When four users step into the space, the full ensemble reveals itself with users being able to interact with each other to improvise and reinterpret the recorded piece.

3.2 Political Context

The idea behind this installation was a narrative on the increasing use of border walls between countries. At the time of creation, Donald Trump was campaigning for US president with his strong narrative on building a wall between the USA and Mexico. Through research, it was found that when the Berlin Wall was torn down a quarter of a century ago, there were sixteen border fences around the world. Today, there are sixty-five, either completed or under construction (Tomlinson, 2015). The lyrical content of the piece is based on a poem by Robert Frost, entitled *Mending Wall* (1914). The poem is about two farmers who live next door to each other. Every summer they both meet to help fix up the wall that separates their fields. There then follows a discussion between the two whether the wall itself is actually needed. I felt the words were quite poignant and appropriate for the theme so an extract was used.

3.3 Musical Process

A traditional score was produced for the original singers to sing from. The lyrical content of the piece is based on a poem by Robert Frost, entitled *Mending Wall* (1914). The musical arrangement was inspired by a choral piece by Gustav Holst called *I love my love* (1917). I wished to convey a similar sombre tone to this piece and decided to adopt the same Dorian mode. A musical consideration needed to be taken regarding the key of the piece and the notes used as, at any given moment, an almost infinite number of possible permutations can happen due to the overlapping layers of audio. This can create all manner of different harmony, so it was important to choose a range of notes that would sound appropriate when played against each other at the same time. Slow rhythms and an overall slow tempo were also used to convey the sad tone.

Each singer needed to sing their individual part in isolation from each other to eliminate any noise bleed between singers. To achieve this, I had to conduct each singer individually, whilst listening back to a metronome from a pair of headphones. This allowed each singer to stay (relatively) in time with each other when piecing the recordings back together. Although, this was not entirely needed as the piece of music would never be played in its written from, from start to finish.

3.4 Technological Process

Motion sensors come in all forms, but I wished to find a solution that could track individual users in a given space. I was already familiar with the Microsoft Kinect Sensor and had previously worked with one on previous projects. This became an obvious choice due to its familiarity. The sensor includes everything needed to track several users independently and can be easily integrated into software due to its open source SDK. A third-party Max external created by Dale Phurrough, called *dp.kinect*, was used to interface with the Kinect Sensor through Max. The external uses the Microsoft SDK directly and therefore works seamlessly in extracting data from the sensor. The package is also well documented, making it easy to set up and get running. The only drawback is that, because the external utilises the official Microsoft Kinect SDK, it can only be run on a Windows PC. Also, the sensor itself requires a USB 3 connection. Using the external, the x and y coordinates of each user (up to a maximum of four users) are extracted and then used to control the parameters of the installation. A renumbering system to keep track of these users needed to be implemented due to the shortcomings of how the sensor originally labels users. Originally, the first user detected by the sensor is labelled as number one. The next user to be detected is then labelled as number two. If the original user then leaves the space, the second user is relabelled as number one and their original label is freed for the next user. This system was problematic, as in practise, users were jumping between which video they were controlling. The implemented system allowed for each user to retain their given label number, regardless of users leaving the space.

The x coordinate of the user is mapped to the playback of the audio and video position. Users can walk from left to right, scanning through the video, much like a tape head over analogue

tape. The granular process loops from this position. The y coordinate of the user (the distance the user is from the sensor), is mapped to the length of the granular loop. The closer the user is to the sensor, the shorter the loop becomes, creating a 'stuttering' grain cloud. The further the user from the sensor, the longer the grain length, thus creating a smoother texture. This y coordinate was also mapped to a reverb effect built in Max. The closer the user is to the sensor, the drier the sound becomes, with a user at distance creating a much wetter, reverberated sound.

The granular processor, or synthesizer, was built and used within a poly object to create a maximum of sixteen voices of polyphony per audio track. The video and audio are processed separately. To synchronise the audio and video, an output was created from the granular object to display the playback time in milliseconds of the first voice (the playback of the audio drives the playback of the video). This value is then converted into frame position, which in turn controls the playback position of the video. It was important to choose an appropriate amount of voices used by the granular processor as the use of too many voices would could strain the CPU, especially when precise video playback is taking place at the same time. After experimentation, sixteen voices per processor seemed to be the optimum limit. Initially, a blurring system was built in for the video, layering multiple tracks of the same video at different frame positions. This created a similar affect to Akemi Takeya's piece, however, the video became too blurred and lacked clarity. This feature was disbanded and only one video track is used per choir member.

3.5 Summary

When making the original recordings, the singers found it hard to keep in exact time of my conducting. This was due to each singer singing in isolation. Because of this, if each recorded part was played back together in time, some of the clips would drift in and out of synchronisation. This didn't really become a huge problem for the installation, as the piece was never intended to be played back in its original written form.

There were a few technical problems due to how complicated the system was. Given more time, further debugging could have taken place to refine these techniques. Some of the errors include; videos becoming frozen when users leave the space (instead of ceasing to be displayed) and users not being fully tracked. Some of these problems may actually come down to the limitations of the Microsoft Kinect Sensor itself, rather than the programming. Users can block other users from being seen by the sensor, thus removing them from interaction.

Contextually, the piece may be seen as a little disjointed. The link to border walls could be seen as a little tenuous. I believe this could be rectified by making the text of the piece more legible when being played back. The score produced, in practise, was too long. The viewing range of the sensor was far smaller in ratio to that of the length of the content. This meant that fast movements made the video jump very quickly to another point. A shorter score used should allow for more legibility in the words when audience members move around the space. This may help people to understand the purpose of the piece better. I also think the programme notes for the piece could have presented a better link between the actual granular process used and that of

topic in general. Perhaps stating something to the affect that the “frozen like choral figures mirror the frozen state of asylum seekers in their new society.”

There are definite links between *If the walls could sing* and Rozin’s *PomPom mirror*. Both pieces use direct translation of body movements as the interactive method. Whereas Rozin’s work is normally focused on creating a translated mirror of the viewer, *If the walls could sing* is about assigning the viewers’ movement onto someone else through the use of an avatar (choir member). Rozin’s piece is akin to a two-dimensional shadow cast from the user, whereas *If the walls could sing* looks to translate three-dimensional data of the viewer onto the displayed avatar. Rozin’s real strength is the mechanical workings of his installation which are extremely intricate and precise. *The Treachery of Sanctuary* goes beyond the simple “sillouhette” mapping found in Rozin’s work, and in my own, by utilising skeletal mapping. Whilst I did intend to originally include this form of mapping I felt that the extra layer of control would not create obvious feedback for the viewers and would become something rather arbitrary. It is obvious in *The Treachery of Sanctuary* how direct the viewers interaction is due to the augmented mirrored effect. *DELQA* takes the skeletal tracking to the next level, however the interactive feedback becomes blurred due to the lack of connection between viewer and installation. It was important for *If the walls could sing* to be clear in how users are interacting both visually and sonically.

4. #MAX140BEATS

4.1 Synopsis

This piece of work was developed from my study into the use of mobile technology as a real-time interactive tool within an installation environment. My original intention was to create a piece of work which allowed the interaction of multiple users from within a specific space. This original manifestation was based around the creation of a MIDI controlled device that users could then connect to and manipulate. After further research, I started to look at web applications and using internet connectivity to house some sort of interface. This would then allow users the ability to interact without having software pre-installed onto one's device. After researching several solutions, it emerged that social media could be the perfect solution for this. Social media allows easy access of communication, with many people already holding accounts with providers such as Facebook, Instagram and twitter. The positive thing with such providers is their API is generally easy to access for the purpose of App development.

Initially, communication via Twitter was to only form the process of interaction, the rest of the piece was to be based around another idea and subject. In fact, a separate performance type interactive installation was built and displayed at MiniBEaST performance (Birmingham) in 2017 which allowed users to send instructions via Twitter, this in turn changed the outputted music. The Twitter part of this work was only used as a method of communication. The musical system employed was independent to the theme of Twitter and was based on a sequencer which used John Conway's *Game of life* (1970) to create generative based compositions. Users were able to Tweet in a set of coordinates to add coloured blocks within the sequencer grid to form the basis of how the music is generated. However, after testing this piece within this environment, it

became clear that a different musical system needed to be created as the installation presented needed constant user interaction to work effectively. Therefore, it made sense to contextualise the whole piece within Twitter. I then set upon looking into how music could be made from tweets themselves, looking upon sonification as a process to convert each Tweet into a musical composition.

Each fragment of the Tweet is extracted and used to create a different musical part. These are; username, the content of the tweet, hashtags, tagged Twitter accounts (or @ signs) and web links. This allows for a maximum of five different parts at one time. If none of these exist within there will still be at least two active parts as a Tweet will always contain a username and some form of message content. Each musical part is assigned to a separate musical voice, the choice of which changes depending on the tone of the Tweet. The tone of the Tweet also determines the overall mood of the piece created. A positive Tweet will create a lighter piece of music, whereas a negative Tweet will produce a darker sound.

4.2 Political Context

The focus of this work became a narrative to the ever-growing amount of spam and troll accounts found on Twitter. A study from the University of Southern California and Indiana University (2017) found that up to 48 million Twitter users, or 15% percent of all users are actually bots (Varol et al., 2017). The National Bureau of Economic Research (2018) also concluded that automated tweeting played a small, but potentially decisive role, in the 2016 Brexit vote and Donald Trump's presidential victory (Gorodnichenko, Pham and Talavera, 2018). Their rough calculations suggest bots added 1.76% point to the pro-'leave' vote share as

Britain weighed whether to remain in the European Union, and may explain 3.23% points of the actual vote for Trump in the U.S. presidential race. On top of this, Networked Insights (2015) estimated that almost 10% of all of Twitter content is spam (Fast Company, 2015). Some brands are dominated by spam, with Networked Insights' research showing that 95% of the mentions of Rite Aid on social media are spam messages, as are almost all mentions of Elizabeth Arden. The point of the work was for audience members to target these spam Tweets and turn them into musical compositions.

4.3 Musical Process

A sonification process is implemented to convert the text contained within the Tweet into music. Many techniques exist in turning text into music, however I decided to settle on a form of music cryptography, similar to the 'Bach motif.' Johann Sebastian Bach used his own name to create musical ostinatos, adopting a method of substituting normal writing letters for musical ones. This literal translation was used successfully in many of Bach's pieces. In this adopted process for the English alphabet, the letters A through to G translate into the musical notes A through to G. After G, the letters H through to N then translate back through to the notes A through to G. This happens in banks of seven letters until the end of the English alphabet is reached. This process forms the pitches used throughout the composition, with each element of the Tweet processed to create a musical clip or ostinato.

To create the rhythms of the piece, an algorithm is used to detect the total amount of content contained within the piece. If the Tweet contains few elements, a selection of longer rhythms is used, such as more crotchets than quavers. If the Tweet contains many elements, more shorter

rhythms are used, such as more quavers than crotchets. The total content of the Tweet also has a direct impact on the tempo of the piece. A fast tempo iss produced when the content contains many elements and a slower tempo for when the content contains fewer elements. However, the length of the piece is always constrained to the total character count of the Tweet, with the amount of characters defining the total amount of beats.

As each created musical phrase is of a different length, it made sense to loop each of these indefinitely until the end of the piece. However, structurally this can sound a little boring, with every part sounding at the same time from start to end. Therefore, another algorithm was implemented to create a structural form for the piece. Much like the process used for the creation of rhythms and overall tempo, the overall structure is also linked to the amount of content contained within the Tweet. The more content contained, the more layered the composition will become, with parts rarely not being played. If the there is little content, there becomes more chance of parts coming in and out of the composition. However, there is always at least one part playing, that of the username.

The key of the piece is affected by the sentiment of the tweet, with a positive Tweet resulting in a Major key and a negative Tweet resulting in a Minor key. However, the problem with using this type of musical cryptography system is that there is no anchor point to the key. For example, a piece intended to be in C Major could be mistaken for being in A Minor as the melodies do not resolve to a tonal centre. To help anchor the piece to a given key a process was used to substitute the first note of each musical phrase with the note of the key. As the username is always present within a Tweet, regardless of any other content, it was decided that the first letter of the

username would create the tonal centre using the same music cryptography for the musical content.

The timbre of the piece was chosen from the General MIDI voices, standard of old soundcards and keyboards. This was an intended decision, as to keep the aesthetics of the installation light hearted. This also had the added benefit of keeping audio latency low and allowed the program available to run on any computer. An algorithm was created to choose which GM sound would be used for each part. This was linked to the overall sentiment of the Tweet. The more positive a Tweet, more humorous sounds were used. A more negative Tweet would select darker and abrasive sounds.

4.4 Technological Process

The main technical process of the installation is the ability to access Tweets from Twitter. It was therefore necessary to access the API to generate searches and then extract Tweets and user information. Thankfully, Max/MSP makes it possible to execute Javascript code from within it, making it a fairly straightforward process to access the Twitter API. A simple Javascript code was created with the ability to make simple searches and return the most recent Tweet and the sender's Username. Creating a Javascript code is well documented on the Twitter website.

The sentiment analyses system was created using two dictionaries, one containing a list of positive words, and the other negative words. Once a tweet is received, it is then compared to each dictionary. Matching words are then extracted, counted and compared. If the Tweet

contains more positive words than negative it will determine the Tweet to be positive. The opposite is true if there are more negative words present than positive. If there are an equal amount of positive and negative words, then the Tweet is determined to be positive overall. The use of a dictionary system like this can cause problems as many languages use negative words in a positive sense or use sarcasm with the use positive words. Therefore, the sentiment detection is never one hundred percent correct. However, this become a 'quirk' of the piece and it was decided to leave the process as it was. In fact, from this error I created a series of compositions named *Trump in C Major* where three tweets by Donald Trump were sonified in the Major key. These pieces of music were then displayed on an online exhibition at ART 23, based in Amsterdam. The dictionary of positive and negative words were taken from a Github created by Minqing Hu and Bing Liu. These originally formed part of two papers authored by the pair; *Mining and Summarizing Customer Reviews* (2004) and *Opinion Observer: Analyzing and Comparing Opinions on the Web* (2005). I have added to the dictionary of words to include more modern colloquialism of the past decade.

The main musical processor of the piece is that of the third-party Max/MSP library *Bach.* This package, created by Andrea Agostini and Daniele Ghisi, is a library of notational tools to allow traditional scoring in Max, a process that is not originally present within Max. The preference for using the notation method was, not only to allow for easier message translation, but to also allow the seamless creation of MIDI information for easy playback from a GM device/soundcard. I could therefore easily compile the converted pitch and rhythm information into notation and store it as standard musical notation. An added bonus of this is the ability to create a real score for live musicians with traditional instruments, a further development for a future project.

The visual element of the piece was a rather simple display, in keeping with the ‘clean’ interface of Twitter. The same colour blue was used as the backdrop display with the written content of the Tweet displayed in black. On first viewing, the installation displays a simple operation instruction to the user. Once a Tweet has been received, the installation displays the written content of the Tweet. To add movement to the display, different colour Twitter logos were created and assigned to each musical part. When a note is produced from a specific part, the coloured logo assigned to that part will pulse on the display, with the vertical position determined by the pitch and it’s horizontal piece decided randomly.

4.5 Summary

The main technical problem was the inability to extract and display ‘emojis’. Emojis now form a large part of written language over social media and can well determine the sentiment of the Tweet. As the system created looks at each character independently and not comparatively, it was impossible to determine whether an emoji was present in the text. Also due to the shortcomings in the Jitter display system within Max/MSP, emojis aren’t automatically displayed when the character combination is used. Perhaps with more time a system to display emojis may be able to be displayed. Another shortcoming was that the installation was only built for English language Tweets as the sentiment dictionaries used are only in English language. Working with other languages would have been a massive undertaking, especially when using non-European languages.

The piece overall was well received when displayed at TESTT space, Durham. Many participants were involved in interacting with the installation throughout the opening night. As the interaction was reasonably instantaneous, and the process obvious, the context of the piece was adequately understood. The programme notes were also concise in explaining the context. There was, however, some negative feedback regarding the timbre of the sounds used, with some participants not being fond of their style. However, this was a desired character of the piece.

#max140beats provides a slightly different interaction method not found in other example pieces. Whereas *#tweetscapes* (2011), allows viewers to Tweet into the installation, they merely become a small part of a wider stream of Tweets, not the central focus of the piece. Also, as the work looks at all German language Tweets, the installation is not site-specific to the installation. *#max140beats* allows users to play the focal role in how the installation changes with a definite link between user input and the feedback obtained. The individual viewer takes total control of the system at one specific time. The same lack of viewer focus can be said about *The Listening Machine* due to the pre-determined links to specific Twitter accounts. Viewers cannot directly interact with the work but are merely observing a stream of anonymous Twitter events. Although, the strength of *The Listening Machine* is its sonification process made up of instrumental sounds recorded from orchestral instruments. This allows the work to be more sonically accessible and less esoteric, with *#tweetscapes* creating a rather abstract, electroacoustic soundscape. It was my intention with *#max140beats* to provide this level of accessibility for viewers. *MONOLITT* does allow instant feedback from interactive users due to the restricted GPS location searches. Feedback is also visually presented instantly but is also long-lasting. The nature of how each Tweet is displayed as a paint ring allows the visible

feedback to remain present for a length of time, allowing viewers to look back into the past. This feature is unique to this piece of work and allows for changes in moods to be tracked over a specific time frame.

Contextually, the message behind *#max140beats* differs from the other pieces presented in that, instead of creating a running commentary of the mood of Twitter users, it looks to simply create music from Tweets. The focus is for viewers to seek out “spam” Tweets or Twitter “bots” and turn these into music, commenting not on the amount of data available but the amount of fake accounts on Twitter.

5. 8BIT NEWS

5.1 Synopsis

Continuing the exploration into sonification, I wished to create a piece of work that could be left to run, creating an indefinite piece of music. There have been many examples of sonification of real-time date, such as Will Parry's *The Note Exchange* (2016) which sonifies stock market data. In fact, Samuel Van Ransbeeck created an opensource Max package, named *DataScapR* (2014), which does this ‘out of the box.’ My installation builds on this idea but focusses on another type of information source, that of news reports.

A wide range of news sources are used; left-leaning, right-leaning and centrist outlets. These media outlets are then regularly polled for new reports. When a new report comes in, the installation converts the text into binary form, displaying it as scrolling text (a list of 1's and 0's). These numbers are then used to trigger sounds, effectively turning the reports into a large musical sequencer.

As the ASCII text format is in eight bit form, it made sense to draw inspiration from the music tracker software of classic eight bit consoles and computers, developed in the 1980s. The sound of these early music making programs formed the inspiration of the overall tonality of the piece, using a similar type of sound synthesis. The way the musical content is arranged is also inspired by such programs, with a top to bottom scrolling sequencer implemented.

As the installation runs indefinitely, it will constantly create an ever-changing soundscape, changing dependent on the news reports received. Sometimes the installation turns to silence as it awaits new reports and then it may spring to life as a barrage of new reports come flooding in.

5.2 Political Context

Around the time of creation, in current affairs, Donald Trump was running for election and his use of the term ‘fake news’ became the ‘topic of conversation.’ This subject matter then formed the core idea of the piece, in thinking how news reports could be used to generate music. The purpose was to strip all bias and fiction from the reports by converting them into an illegible form. It was decided to convert the text into their fundamental computer form and in doing so make the report incoherent and unreadable.

5.3 Musical Process

The timbre of this piece is inspired by 8bit tracker programs. These programs were originally developed in the late 1980s, running on home computers such as the Amiga and Commodore 64. They were originally very limited, only supported four pitch and volume modulated channels of 8-bit PCM samples. To imitate the typical sounds of these programs I intentionally used two VST instruments that emulated 8bit sounds. These VSTs are called *Triforce* and P*each*, both made by the software company Tweakbench. One instance of *Triforce* was used and two instances of *Peach* were used, providing sound for each group of news outlets. Each instance uses a different timbre as well as occupying a different frequency register, with the left leaning sources occupying the bass range, the centrist sources occupying the middle frequency range and the right sources occupying the higher frequencies.

The playback of the installation is similar to that of a music tracker program, with a sequence presented in a linear fashion from top to bottom. Each row represents a step of the sequence. The playhead of the sequencer plays from the top to the bottom also. As the ASCII text format is made up of eight bits, each character of the news report is converted and displayed as an eight bit binary string. Each of the eight binary digits are assigned to a note from the major scale of C. Whenever a number one is displayed, its corresponding note will play. Whenever a number zero is displayed, it's corresponding note will remain silent. For example, the binary number 10010010 would play a chord with notes CFB. The binary number 10111111 would play the chord CEFGABC. As discovered in practise, these binary numbers are often made up of multiple 'ones', therefore chords are generally produced. This works well with one voice, however, when three voices are all playing chords, the texture can become too thick and incoherent. To rectify this, only one voice was used to play the chords in full, with the other two voices being played as an arpeggio. Unlike in *#max140beats* where a tonal centre was created, the music from this piece straddles both the major scale and its relative minor. This was a desired effect.

5.4 Technological Process

The main technical challenge was that of retrieving the news reports directly from the news sources. Many websites use thee RSS protocol to send out bulletins or to update website blogs, withe most media outlets, choosing this method to post out the latest headlines. These RSS messages are stored as XML formatted messages, a message format similar to HTML. Due to XML files using headed tags, it can be easily parsed to extract each individual part of the message. As another bonus, XML files themselves are also very small in size, thus can be

downloaded and processed very quickly. To parse these files, a third party external named *sadam.rapidXML*, created by Ádám Siska, was used. This made it easy to search the XML file for each new headline using a simple query to find the most recent dated entry. Max's native object *maxurl* was used to download the XML files directly from the sources. This object is triggered regularly every thirty seconds to check for a new file.

The sonification process used is different to that of the piece *#max140beats*. The point of this installation was to convert the text into an illegible form, and then in turn, convert that into music. The process was decided to turn the reports into binary form first. This was accomplished by first turning each character into an ASCII number first. It was then easy to convert this number into binary. Each report is then displayed as a scrolling binary number, with each letter of the story displayed at a single pass of the sequencer.

Max/MSP Jitter was used to display the binary numbers on screen. The binary numbers are arranged in three columns, depending on their political leaning. Eight news sources are used from each group. A simple black and white interface was chosen as a similar aesthetic to music tracker programs. The text font used was called *Commodore 64 Pixelized* by Devin Cook. This 'retro' style font also added to the aesthetics of the piece.

5.5 Summary

Technically, this was one of the most successful pieces. The method of downloading RSS feeds was very reliable, as was the sonification process. Some adaptability was needed as when the installation was run it was found that there far too many large chords being played at the same time. A solution was needed to break up some of these chords, thus arpeggiation was used. One problem was that the VST used for playback only ran in 32bit mode. This wasn't a huge problem, but some modern DAWs now only use 64bit environments, such as Ableton Live 10.

Contextually the piece felt very strong. I felt the meaning of the piece was adequately portrayed with help from the accompanying programme notes. There was some initial concern in how long the installation could remain silent at one time. Thankfully, the frequency of new reports was enough to make the installation not become inactive for a lengthy period of time. In fact, an interesting observation, that was only discovered in practice, was how frequently the right-wing press released new news reports compared to that of the left or centre. A lot of the time only reports from the right can be heard.

Whilst *8bit news* does not build specifically on previous uses of real-time data, it does extensively use and explore the given medium. Similar in workings to *Listening Post*, the piece extracts simultaneous data in real-time and displays the data in a layered form. The visual link is also similar with both pieces displaying the input of data in real-time. However, *8bit news* looks to create a more "musical" environment through parameter-mapping sonification, rather than the synthesized readings found in *Listening Post*. Unlike *Sonicity: Songs of Atoms Time and Space* and *Flow*, *8bit news* does not use sensor equipment, relying on external data obtained from the

internet. This is similar to the piece *London Data Streams*, which obtains real-time Twitter communications from via the internet.

Most works which utilise the use of real-time data concern themselves with the surrounding environment, such as *flow*, or make comment on the sensitivity of data, for example in *Listening Post*. *8bit news* provided a slightly different angle. In using real-time data from a range of news sources it focussed the piece on the frequency of news reports being published and ultimately made comment on right-leaning tabloids being more periodic in there posting.

6. CONTEXTUAL OVERVIEW

Each piece presented in this portfolio builds upon already existing works and techniques. The pieces all provide slightly different technical methods found in the contextual research. *#max140bits* allows users direct control over the system, finding Tweets to be sonified and allowing one Tweet at a time to take central focus. The sonification process, although relying on already established parameter-mapping sonification techniques, creates a range of musical pieces with very contrasting styles. Music cryptology has been around for hundreds of years, but the piece combines this with sentiment analysis techniques developed in the 1990s. This technique can also be seen in the pieces *The Listening Machine* and *London Data Streams*. *8bit news* utilises teal-time data input from online sources instead of sensor equipment, another modern practice found in the works of *London Data Streams*. Again, parameter-mapping sonification is employed, but this time in a different fashion as *#max14beats*, expanding the sonification techniques within my practice. *If the walls could sing* explores the use of the Microsoft Kinect, much like Rozin's piece *pompoms*, but looks to use the three-dimensional environment in a more developed system to add more expression to the viewer's interaction experience. Although not used extensively, the features of the sensor was appropriate to the system made. *8bit news* finds new data for sonification in the form of RSS messages to create ever-lasting musical soundscapes. Parameter mapping sonification was used again, but this time in a contrasting method to *#max140beats.*

Each piece has contributed to the development of my own practice and has expanded my knowledge and skill set in regard to; interactive musical systems and the technological techniques needed. For example, most of my experience is within Max/MSP. It was therefore

valuable to use the Javascript language, a language I previously had little knowledge of, to access the Twitter API in *#max140beats*. Sonification was also a process I was aware of but had no experience of. This portfolio allowed me to explore the different methods of sonification and the process of parameter-mapping sonification as found in other works.

7. APPENDICES

7.1 Appendix 1: Programme Notes

If the walls could sing

"If the walls could sing", is an interactive audio/visual installation which enables participants to personify an individual member of a close harmony ensemble.

The space is seemingly empty, but as an observer enters, their choral 'avatar' is projected and they start to sing. The observer's movement within the space is then used to control the singer, scanning through their performance. As more observers enter the space, more singers appear, allowing collaborative interaction of a normally linear musical piece.

The words of the piece are based on the poem *Mending Wall* by Robert Frost, in which two farmers discuss the need for a wall between their lands.

When the Berlin Wall was torn down, more than a quarter of a century ago, there were 16 border fences around the world. Today, there are 65 either completed or under construction.
The sombre tone of this piece reflects the sadness of keeping humanity divided.

Performers: Gabbi Freemantle, Heidi Pegler, James Wakerell, Roger Paul.

#max140beats

A study from the University of Southern California and Indiana University (2017) found that up to 48 million Twitter users, or 15% percent of all users, are actually bots. In fact, 53% of Justin Beiber's followers are estimated to be bots (Soicalbakers, 2014).

The National Bureau of Economic Research (2018) also concluded that automated tweeting played a small, but potentially decisive role, in the 2016 Brexit vote and Donald Trump's presidential victory. Their rough calculations suggest bots added 1.76% point to the pro-'leave' vote share as Britain weighed whether to remain in the European Union, and may explain 3.23% points of the actual vote for Trump in the U.S. presidential race.

On top of this, Networked Insights (2015) estimated that almost 10% of all of Twitter content is actually spam.

Some brands are actually dominated by spam, with Networked Insights' research showing that 95% of the mentions of Rite Aid on social media are spam messages, as are almost all mentions of Elizabeth Arden.

#MAX140BEATS was created as a reaction to this theme, turning all of that useless spam into useful music!

8 bit news

"8 bit news" is a reactive installation that uses real-time rss news reports to create live soundscapes.

A wide range of news reports are polled regularly from a range of sources; left-leaning, centre, and right-leaning. Each of these three groups represent a different timbre and tonality. When a new report comes in, the installation converts this text into binary form, displaying it as scrolling text (a list of 1's and 0's). These numbers are then used to trigger sounds, effectively turning the reports into a large musical sequencer.

'Fake news', either as a statement of fact or as an accusation, has been inescapable this year (2017), contributing to the undermining of society's trust in news reporting: given the term's ubiquity and its regular usage by President Trump, it is clear that Collins's word of the year is very real news.

- **Helen Newstead** (HarperCollins Publishers)

By breaking down these news reports into their simplistic digital form, we remove all bias and influence; what we are left with is a sonified reinterpretation.

The installation runs indefinitely, constantly creating ever-changing soundscapes. Sometimes the installation turns to silence, awaiting new reports, then a breaking news report comes in and the installation springs into life.

As the ASCII text format is in 8 bit form, it makes sense to draw inspiration from the music tracker software of classic 8 bit consoles and computers.

7.2 Appendix 2: List of external content used

Dp.kinect by Dale Phurrough – Max/MSP external used in *If the walls could sing*

https://hidale.com/

Syxg50 VST instrument by Evgeny Vrublevsky – Used in *#max140beats*

http://veg.by/en/projects/syxg50/

negative-words.txt and ositive.words.txt – Sentiment dictionaries used in *#max140beats*

https://goo.gl/bgiWtu

Triforce VST instrument by Tweakbench – Used in *8bit news*

http://www.vst4free.com/free_vst.php?id=1781

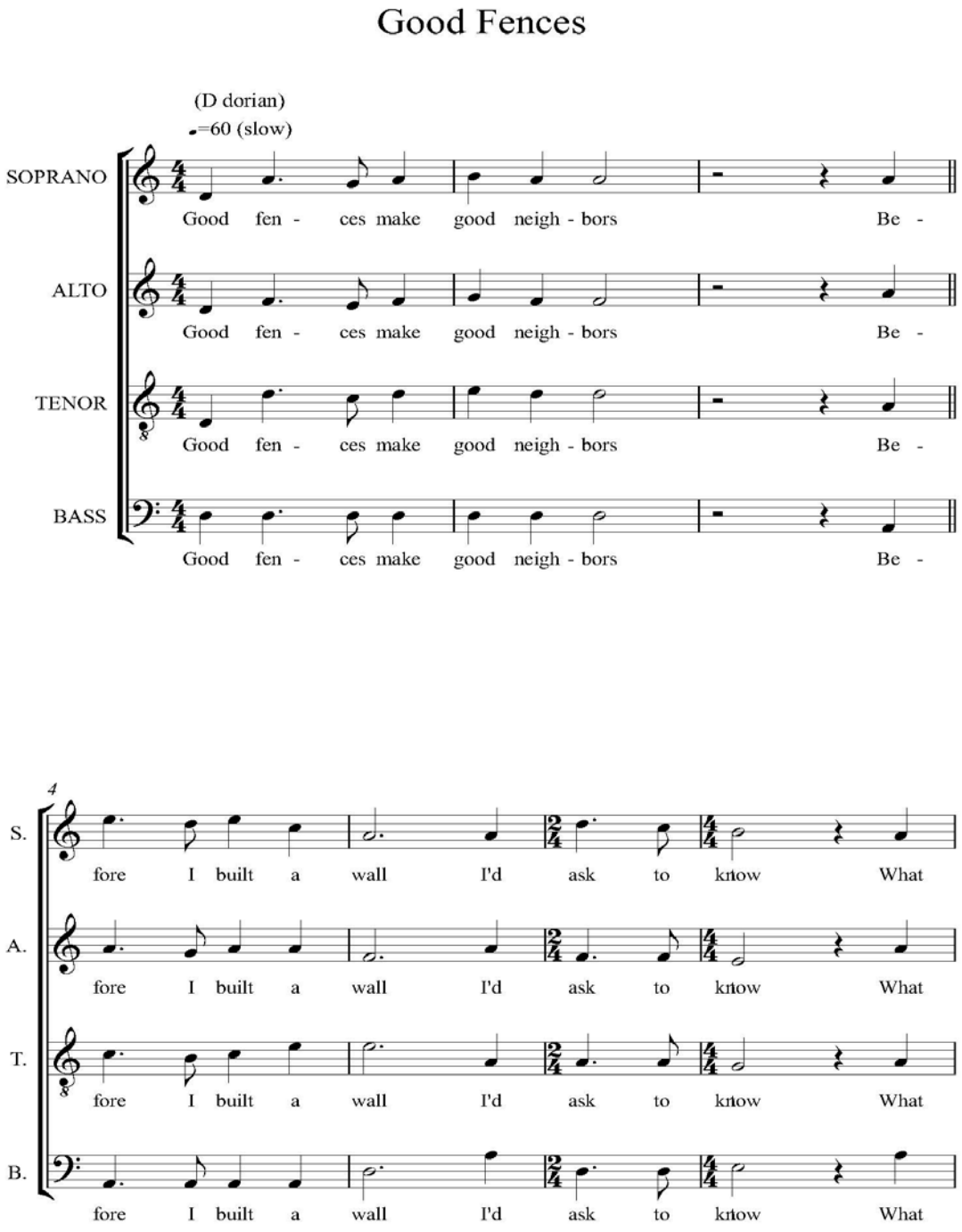
Peach VST instrument by Tweakbench

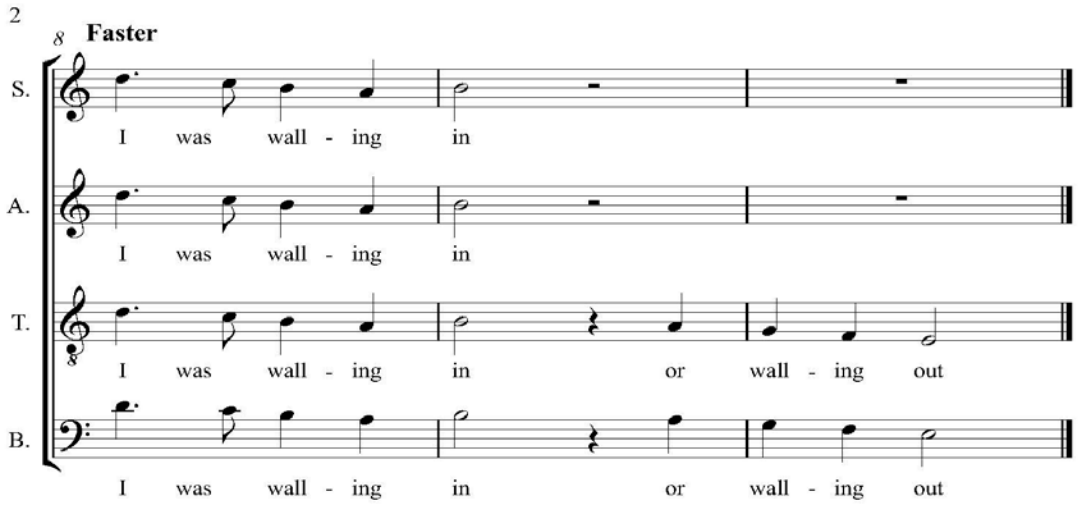
http://www.vst4free.com/free_vst.php?id=1775

Sadam.rapidxml – Max/MSP external used in *8bit news*

http://www.sadam.hu/en/software

7.3 Appendix 3: Vocal score for *If the walls could sing*




2
8
Faster
S.
I was wall - ing in
A.
I was wall - ing in
T.
I was wall - ing in or wall - ing out
B.
I was wall - ing in or wall - ing out

7.4 Appendix 3: Words to the poem *Mending Wall* by Robert Frost

Something there is that doesn't love a wall,
That sends the frozen-ground-swell under it,
And spills the upper boulders in the sun;
And makes gaps even two can pass abreast.
The work of hunters is another thing:
I have come after them and made repair
Where they have left not one stone on a stone,
But they would have the rabbit out of hiding,
To please the yelping dogs. The gaps I mean,
No one has seen them made or heard them made,
But at spring mending-time we find them there.
I let my neighbour know beyond the hill;
And on a day we meet to walk the line
And set the wall between us once again.
We keep the wall between us as we go.
To each the boulders that have fallen to each.
And some are loaves and some so nearly balls
We have to use a spell to make them balance:
"Stay where you are until our backs are turned!"
We wear our fingers rough with handling them.
Oh, just another kind of out-door game,
One on a side. It comes to little more:
There where it is we do not need the wall:
He is all pine and I am apple orchard.
My apple trees will never get across
And eat the cones under his pines, I tell him.
He only says, "Good fences make good neighbours."
Spring is the mischief in me, and I wonder
If I could put a notion in his head:
"Why do they make good neighbours? Isn't it
Where there are cows? But here there are no cows.
Before I built a wall I'd ask to know
What I was walling in or walling out,
And to whom I was like to give offence.
Something there is that doesn't love a wall,
That wants it down." I could say "Elves" to him,
But it's not elves exactly, and I'd rather
He said it for himself. I see him there

Bringing a stone grasped firmly by the top
In each hand, like an old-stone savage armed.
He moves in darkness as it seems to me,
Not of woods only and the shade of trees.
He will not go behind his father's saying,
And he likes having thought of it so well
He says again, "Good fences make good neighbours."

7.5 Appendix 4: Trump in C Major

Trump in C Major is a body of four compositions created from the installation *#max140beats*. The work was submitted to the Studio 47 open call in 2017. The call was for internet-based works that would be Tweeted to the USA President Donald Trump as a counterweight to his right-wing rhetoric. The pieces were chosen and added to the online exhibition as well as being Tweeted to Donald Trump. The works used four of Trump's own Tweets and were sonified using the same system within *#max140beats*. However, the sentiment identifier was turned off, making each created composition in the key of C Major. The transcript of the Tweets and which piece they represent are displayed below.

Trump 1

> The FAKE NEWS media (failing @nytimes, @NBCnews, @ABC, @CBS, @CNN) is not my enemy, it is the enemy of the American people!

Trump 2

> The fake news media is going crazy with their conspiracy theories and blind hatred. @MSNBC & @CNN are unwatchable. @foxandfriends is great!

Trump 3

> Beginning today, the United States of America gets back control of its borders. Full speech today @DHSgov: bit.ly/2jSZomhDHS

Trump 4

> We will follow two simple rules: BUY AMERICAN & HIRE AMERICAN! #InaugurationDay #MAGA

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